Angler Effort and Catch in the 1998 Sport Fisheries of the Capilano and Squamish Rivers

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by

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ABSTRACT

Palermo, V. and A.S. Thompson. 2000. Angler effort and catch in the 1998 sport fisheries of the Capilano and Squamish rivers. Can. Manuscr. Rep. Fish. Aquat. Sci. 2529: 29 p.

The Capilano River sport fishery was assessed from July 1 to October 31 and November 18 to 30, 1998 using a hybrid creel study design. The survey focused on angler effort and the harvest and release of coho salmon (*Oncorhynchus kisutch*). Over the course of the Capilano River survey, 3,666 angler interviews and 28 instantaneous effort counts were conducted. Angler effort was estimated at 46,873 hours. The total harvest of coho salmon was estimated at 1,024 and the number released was estimated at 1,039.

The Squamish River sport fishery was assessed from October 1 to November 30, 1998, using a roving creel study design. The survey focused on angler effort and the harvest and release of chum (*O. keta*) and coho salmon. Over the course of the Squamish River survey, 1,582 angler interviews and 14 instantaneous effort counts were conducted. Angler effort was estimated at 14,736 hours. The total harvest of chum salmon was estimated at 1,880 and the number released was estimated at 8,031. The total number of coho salmon released was estimated at 172; none were harvested.

Key Words: Capilano River, Squamish River, sport fishery, coho salmon, chinook salmon, chum salmon, sockeye salmon, angler effort, catch, harvest, release.

RÉSUMÉ

Palermo, V. and A.S. Thompson. 2000. Angler effort and catch in the 1998 sport fisheries of the Capilano and Squamish rivers. Can. Manuscr. Rep. Fish. Aquat. Sci. 2529: 29 p.

Nous avons évalué la pêche sportive dans la Capilano du 1er juillet au 31 octobre, et au 18 au 30 novembre 1998, par une enquête hybride auprès des pêcheurs. L'enquête était axée sur l'effort de pêche sportive et sur la capture avec remise à l'eau du saumon coho (*Oncorhynchus kisutch*). Au cours de l'enquête sur la Capilano, nous avons effectué 3 666 entrevues et 28 recensements instantanés de l'effort. L'effort de pêche a été estimé à 46 873 heures. Le prélèvement total de cohos a été estimé à 1 024, et le nombre de poissons remis à l'eau à 1 039.

Sur la Squamish, la pêche sportive a été évaluée du 1er octobre au 30 novembre par une enquête itinérante. L'enquête était axée sur l'effort de pêche sportive et sur la capture avec remise à l'eau du kéta (*O. keta*) et du coho. Au cours de l'enquête sur la Squamish, nous avons réalisé 1 582 entrevues et 14 recensements instantanés de l'effort. L'effort de pêche a été estimé à 14 736 heures. Le prélèvement total de kétas a été estimé à 1 880, et le nombre de kétas remis à l'eau à 8 031. Le nombre total de cohos remis à l'eau a été estimé à 172; aucun coho n'a été prélevé.

Mots clés : Capilano, Squamish, pêche sportive, coho, quinnat, kéta, saumon rouge, effort de pêche sportive, capture, prélèvement, remise à l'eau.

INTRODUCTION

In 1998, the Capilano River was studied to assess angler effort and catch during the summer and autumn sport fishing seasons. The survey ran from July 1 to October 31 and from November 18 to 30; the early part of November was not surveyed due to funding constraints and the closure of the fishery to coho salmon (*Oncorhynchus kisutch*) retention. The hybrid creel design combined roving, access point and instantaneous effort count survey methods. The survey focused on angler effort and catch of coho salmon.

The Squamish River was studied to assess angler effort and catch during the 1998 autumn sport fishing season. The survey ran from October 1 to November 30 and combined roving and instantaneous effort count survey methods. The survey focused on angler effort and catch of coho and chum (*O. keta*) salmon.

This report describes the methods and procedures of the 1998 Capilano and Squamish river surveys and details the total angler effort and catch per unit effort (CPUE), including harvest per unit effort (HPUE) and release per unit effort (RPUE) for the Capilano River from July 1 to October 31 and November 18 to 30, 1998 and for the Squamish River from October 1 to November 30, 1998. Finally, recommendations are made for future surveys and management of the recreational fisheries on the Capilano and Squamish rivers.

STUDY AREA

CAPILANO RIVER

The Capilano River is located in the Coast Mountains of British Columbia; it flows in a southerly direction for 40 km, passing through North and West Vancouver before entering Burrard Inlet approximately 0.5 km west of the Lions Gate Bridge (Figure 1). The river and its tributaries drain a watershed of approximately 190 km^2. The Cleveland Dam is located 6 km upstream from the river mouth, at the outlet of Capilano Lake, which serves as a water reservoir for Greater Vancouver. The river flows within a canyon for approximately 5 km downstream of the dam. In 1998 the Capilano River above the dam intake had an annual mean daily flow rate of 21.2 m^3/s (Water Survey of Canada, pers. comm.). Flow data are not available for the river downstream of the dam. Discharge is regulated through the dam and flow rates fluctuate frequently.

The study area extended from the beaches on either side of the river mouth (Figure 1) upstream to the footbridge located 100 m downstream of the hatchery fish fence; this was the portion of the Capilano River that was open to angling during the study period. The railway bridge served as the tidal boundary; non-tidal fishing regulations were in effect upstream of the bridge, while tidal regulations were in effect downstream of it (Table 1). For the purposes of sampling, the study area was further broken into 7 sections (A to G), as shown in Figure 1. The canyon area between Sections B and C was inaccessible to anglers and interviewers and was therefore not considered part of the study area.

SQUAMISH RIVER

The Squamish River is located in the Coast Mountains of British Columbia; it flows southeast for 108 km, entering the head of Howe Sound 45 km north of Vancouver (Figure 2). The river and its tributaries drain a mountainous, glaciated watershed of approximately 3,636 km^2. In its lower 35 km, the Squamish River flows largely in a single channel and is characterized by fast runs and rapids separated by lower gradient sections with smooth, sinuous meanders (Hoos and Vold, 1975). In 1998 the Squamish River near Brackendale had an annual mean daily flow rate of 241.0 m^3/s (Water Survey of Canada, pers. comm.).

The study area extended from the mouth of the river at the head of Howe Sound to the powerline that crosses the river 1.6 km upstream of the Cheakamus River confluence. This area was the only section of the river open for angling during the study period. For the purposes of sampling, the study area was further divided into 2 sections. Section 1 extended from the mouth upstream to the Mamquam River confluence, while Section 2 extended from the

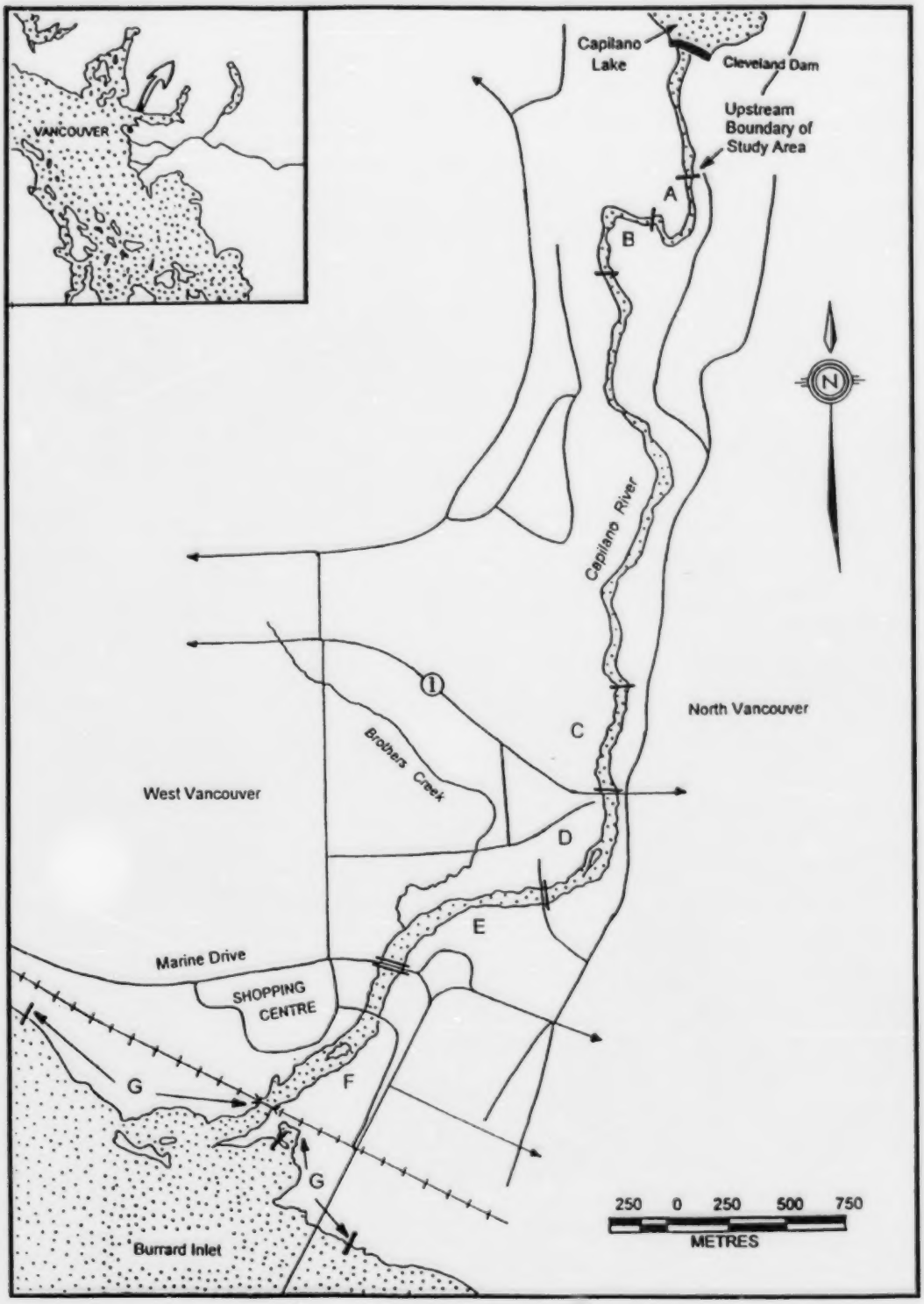

Figure 1. Capilano River sport fishery survey study area map.

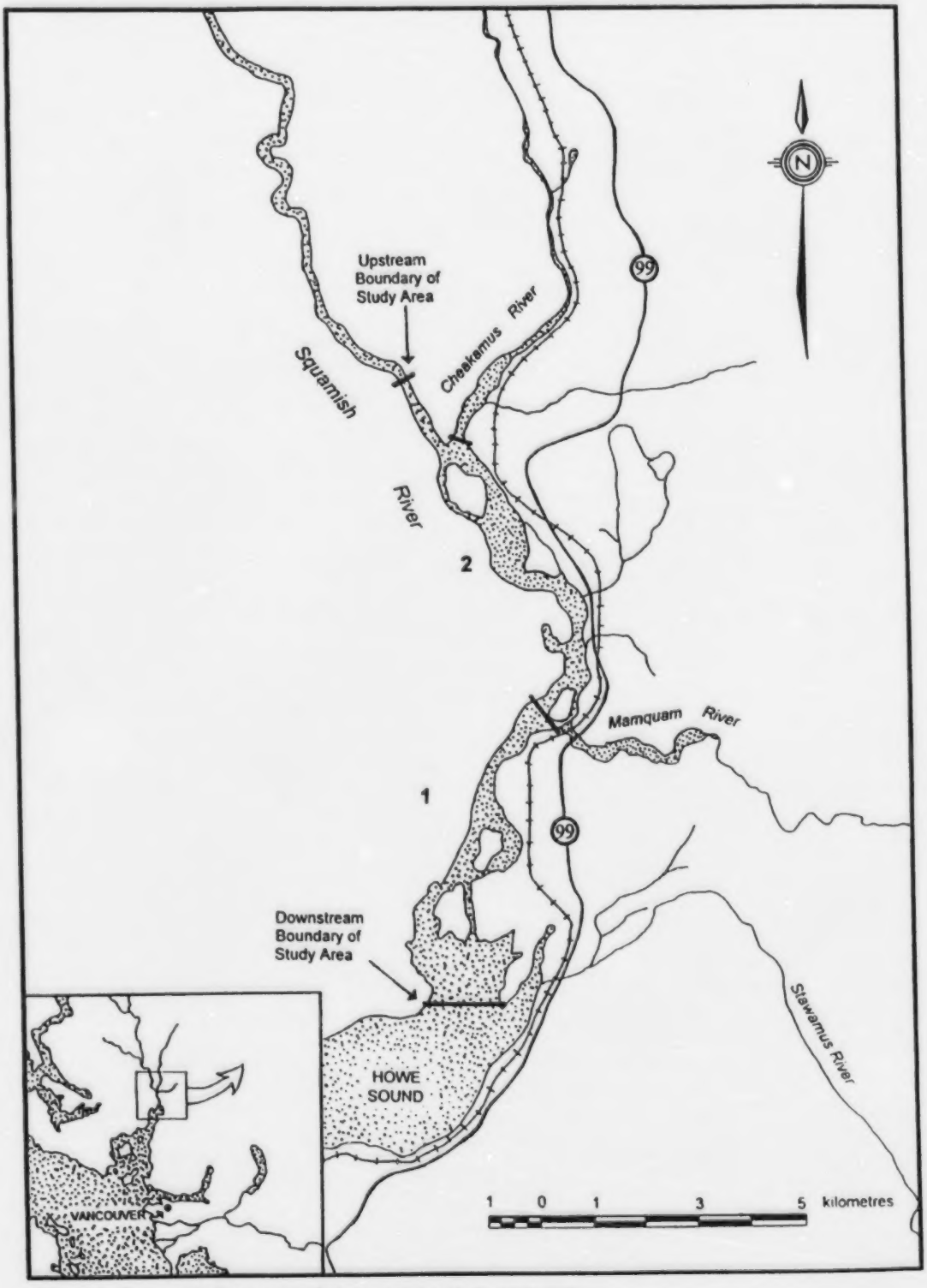

Figure 2. Squamish River sport fishery survey study area map.

Mamquam River confluence to the upstream study area boundary.

FISHERY REGULATIONS

The 1998 Capilano and Squamish sport fisheries were managed by daily and annual harvest limits, fish size restrictions, area closures and species-specific fishery closures (Table 1).

The Capilano River coho fishery opened on July 1, closed on October 31, then re-opened on November 18 and remained open for the duration of the survey. The coho salmon harvest limits during the 2 openings were 2 per day and 4 per day, respectively, except in the tidal portion of the river where the limit remained at 2 per day. There was no annual harvest limit for coho salmon. The chinook salmon fishery opened on October 16 and remained open for the duration of the survey; the harvest limit was 4 per day, with none allowed over 62 cm. The annual harvest limit for adult chinook salmon over 50 cm was 10.

Between October 1 and December 31, the Squamish River was open to angling for salmon species between the mouth and the powerline one mile upstream of the Cheakamus River confluence only. The chum salmon harvest limit was 2 per day. The chinook salmon harvest limit was 2 per day, with none allowed over 50 cm. The annual harvest limit for adult chinook salmon over 50 cm was 10. The Squamish River was closed for coho salmon retention all season.

For both rivers, where applicable, minimum retention sizes were 30 cm for chinook and chum salmon and 25 cm for coho salmon. The aggregate harvest limit for all salmon species was 4 per day.

METHODS

STUDY DESIGN

Capilano River

The Capilano River sport fishery was assessed using a hybrid design that effectively allowed anglers to cover the entire study area (Whyte and Schubert, 1990; Schubert and Whyte, 1992) from July 1 to October 31 and November 18 to 30, 1998. The fishery was not surveyed between November 1 and 17; this was the period when coho salmon harvesting was disallowed and effort on the river probably decreased significantly. Survey days were divided into morning and afternoon shifts, with one of the two surveyors working during a shift. The shifts initially ran from 0700 to 1500 hours and 1400 to 2200 hours, but the survey day was shortened as the season progressed and daylight hours diminished. By the end of the season, the survey day ran from 0800 to 1700 hours, with the 2 shifts overlapping almost entirely. Survey days were further stratified into weekday and weekend (including holiday) day types. Survey shifts took place on all weekend days and holidays and on an average of 4 weekdays per week.

Surveyors began each shift with a roving survey of the river and then stationed themselves at the site of greatest effort (usually near the mouth of the river) for the remainder of the shift. Hourly rod counts were then conducted to build effort profiles and all anglers exiting the access site were interviewed. Interview questions included: number of anglers in the party, completed or intended length of fishing trip, time blocks fished, target species, fishing gear used, total harvested marked or unmarked fish, by species, and total released fish, also by species. With the anglers' permission, the interviewer inspected any harvested fish to verify species and look for adipose clips. At the end of the shift an 'incomplete trip' interview was conducted on all anglers that were still fishing at the access point site. Total complete and incomplete interviews were then tallied for the day on an angler count summary form.

On several days each month, instantaneous effort counts were made by one observer who drove the length of the river and counted all the anglers in the study area. Effort counts were performed during either the morning shift (beginning between 1100 and 1330 hours) or the afternoon shift (with most beginning between 1730 and 1830 hours). The counts lasted between 0.5 and 1 hour, depending on the amount of effort observed. Observers performed an

Table 1. Salmon fishery regulations for species with fishery openings during the 1998 Capilano River and Squamish River sport fishery surveys.

River	Location	Species	Openings	Daily Catch Limits	Annual Catch Limits
Capilano	Non-tidal: BC rail bridge to signs at footbridge 100 m below fish fence	Coho	June 30 - Oct 31 Nov 18 - Dec 31	2 ≥ 25 cm 4 ≥ 25 cm	-
		Chinook	Oct 16 - Dec 31	4 between 30 and 62 cm	10 adults > 50 cm
	Tidal: Point Atkinson to Lions Gate Bridge	Coho	June 26 - Oct 31 Nov. 18 - Dec. 31	2 ≥ 25 cm 2 ≥ 25 cm	- -
		Chinook	Apr 1 - Mar 31	2 ≥ 62 cm	15 adults > 62 cm
Squamish	Mouth to powerline one mile upstream of Cheakamus River *only*	Chum	Oct 1 - Dec 31	2 ≥ 30 cm	-
		Chinook	Oct 1 - Dec 31	2 between 30 and 50 cm	10 adults > 50 cm

average of 3 weekend and 5 weekday instantaneous effort counts each month, except during November.

A total of 3,666 angler interviews and 28 instantaneous effort counts were conducted between July 1 and October 31 and November 18 and 30 in the 1998 Capilano River sport fishery survey.

Squamish River

The Squamish River sport fishery was assessed from October 1 to November 30, 1998. The study design combined roving and instantaneous effort count survey methods (Hoenig et al., 1997) that allowed surveyors to effectively cover the whole study area. Survey days were divided into morning and afternoon shifts; one of the two surveyors worked during a shift. The shifts initially ran from 0700 to 1500 hours and 1000 to 1800 hours, but the survey day was shortened as the season progressed and daylight hours diminished. By the end of the season, the survey day ran from 0800 to 1700 hours, with the 2 shifts overlapping almost entirely. Survey days were further stratified into weekday and weekend (including holiday) day types. Survey shifts took place on all but 2 weekend days and holidays and on an average of 3 weekdays per week.

The surveyors traveled a predetermined route by car, with a randomly selected start point and direction of travel. The surveyor's rate of travel through the study area was standardized to ensure that an entire circuit was completed. Anglers were approached on foot to be interviewed. Interview questions included: number of anglers in the party, completed or intended length of fishing trip, time blocks fished, target species, fishing gear used, total harvested marked or unmarked fish, by species, and total released fish, also by species. With the anglers' permission, the interviewer inspected any harvested fish to verify species and look for adipose clips. At the end of the shift, total complete and incomplete interviews were tallied on an angler count summary form.

On several days each month, instantaneous effort counts were made by one observer who drove the length of the study area and counted all the anglers fishing in it. Effort counts generally began at 1100 hours and lasted about an hour. All instantaneous counts covered Sections 1 and 2. Observers performed 6 instantaneous effort counts in October and 8 in November.

A total of 1,582 interviews and 14 instantaneous effort counts were conducted

between October 1 and November 30 in the 1998 Squamish River sport fishery survey.

DATA MANAGEMENT

Data management procedures are the same as for the 1998 lower Fraser River creel survey and are described in detail in Palermo and Thompson (1999b).

DATA ANALYSIS

Capilano River

More than 80% of the Capilano River interviews were conducted at access points; the data, therefore, were analyzed as if it were a combined access point and instantaneous effort count survey. Before the analysis algorithms were performed, data were stratified according to month, day type, hour and stint. Days were divided into three stints: the period of overlap between the a.m. and p.m. shifts, and the a.m. and p.m. shifts outside the overlap period. Stratification allowed the appropriate weighting of interview and instantaneous rod count data.

Wednesday, July 1 was a national holiday (Canada Day), but because it occurred mid-week, many anglers appear to have taken alternate or additional holiday days to form a long weekend. As a result, the river received increased angler effort between July 1 and 5; all 5 days have been classified as weekend/holiday days for the purposes of analysis. The November results represent only the period from November 18 to 30. Although there would have been some angler effort and catch on the river during the early part of November, they are impossible to quantify without sampling data from that period. Assuming that there was no illegal harvest during the closure, the coho salmon harvest estimate would represent the harvest for the entire month of November.

Angler Effort

Angler effort profiles were generated from hourly rod counts at the survey sites and 'time fishing' data from interviews. Effort information from outside the survey shifts (prior to 0700 and after 2200 hours, for example) was reconstructed from the interview data and used to adjust the daily angler effort profile. Hourly effort was also weighted to compensate for the sampling imbalances resulting from overlapping survey shifts. Mean sample day effort for each stratum (month and day type) was the ratio of the mean instantaneous rod count to the proportion of daily effort occurring during the instantaneous rod count time block. Total angler effort was the product of the mean daily angler effort and the number of days in the stratum. The mathematical relationships are reported below, with variance calculations detailed in Schubert and Whyte (1992).

1) Estimated total rods fishing by hour *j* and day type *h*:

$$\hat{R}_{hj} = \sum_i N_h / n_{hij} \sum_k r_{hijk}$$

2) Estimated proportion of the daily angler effort occurring during the instantaneous rod count time block, by day type:

$$\bar{P}_{hj^*} = \frac{\hat{R}_{hj^*}}{\sum_j \hat{R}_{hj}}$$

3) Estimated mean rod count during the instantaneous rod count time block, by day type:

$$\bar{y}_{hj^*} = \sum_k \frac{y_{hj^*k}}{n_{hj^*}}$$

4) Estimated angler effort by day type, in hours:

$$E_h = N_h \frac{\bar{y}_{hj^*}}{\bar{p}_{hj^*}}$$

5) Estimated study period angler effort, in hours:

$$E = \sum_h E_h$$

where:

N_h = total study period days of day type *h* (weekday or weekend);

n_{hij} = number of interview sample days on day type *h* at site *i* during hour *j*;

r_{hijk} = rod count on day type *h* at site *i* at hour *j* on day *k*;

$\hat{R}_{hj*}$ = estimated total effort (hours) on day type *h* during the instantaneous count time *j**

y_{h*k} = instantaneous rod count on day type *h* on day *k*;

n_{hj*} = number of instantaneous rod counts on day type *h*;

Catch per Unit Effort

CPUE was calculated by day type for each species and mark group, using a total ratio estimator (Von Geldern, Jr. and Thomlinson, 1973; Malvestuto, 1983; Hoenig et al., 1997), i.e., the total estimated catch was divided by the total estimated effort (to time of interview). Estimates were derived from interview data weighted by the proportion of stints that were surveyed. CPUE was calculated separately for harvested (HPUE) and released (RPUE) fish. The mathematical relationships are reported below.

6) Estimated monthly catch to time of interview at the survey sites by day type:

$$\hat{X}_h = \sum_i \sum_l \frac{1}{a_{hil}} \sum_f \sum_q \sum_u \frac{x_{hilfqu}}{a_{hilfq}}$$

7) Estimated monthly angler hours to time of interview at the survey sites by day type:

$$\hat{T}_h = \sum_i \sum_l \frac{1}{a_{hil}} \sum_f \sum_q \sum_u \frac{t_{hilfqu}}{a_{hilfq}}$$

8) Estimated catch per angler hour at the survey sites by day type:

$$\bar{c}_h = \frac{\hat{X}_h}{\hat{T}_h}$$

where:

a_{hil} = proportion of monthly stints of type *l* for site *i* on day type *h* which were surveyed;

a_{hilfq} = proportion of anglers leaving in time block *q* on stint *f* of stint type *l* at site *i* on day type *h* who were interviewed;

x_{hilfqu} = catch to time of interview by angler *u* leaving in time block *q* on stint *f* of stint type *l* at site *i* on day type *h*;

t_{hilfqu} = hours fished to time of interview by angler *u* leaving in time block *q* on stint *f* of stint type *l* at site *i* on day type *h*.

Before calculating CPUE, however, the raw interview data were tested for significant differences in CPUE estimates calculated from all interviews and complete trip interviews only. The test used, from Cochran (1977) was:

9) Estimated variance of the difference between two ratios $Var(\bar{c}_c - \bar{c}_t)$:

$$Var(\bar{c}_c - \bar{c}_t) = Var(\bar{c}_c) + Var(\bar{c}_t)$$

where:

$Var(\bar{c}_c)$ = variance of CPUE from complete trip interviews:

$$\frac{1}{n(n-1)\bar{t}^2}(\sum x_u^2 - 2\bar{c}_c \sum x_u t_u + \bar{c}_u^2 \sum t_u^2)$$

$Var(\bar{c}_t)$ = variance of CPUE from all interviews, calculated as above.

$\bar{t}$ = mean time to interview.

If $(\bar{c}_c - \bar{c}_t) \pm$ (t-table, 0.95) $Var(\bar{c}_c - \bar{c}_t)$ did not include zero, the difference was significant. In that case, incomplete trip interviews were excluded from the analysis for

that site. In 1998 Capilano River survey, approximately 46% of all interviews were incomplete. All of the incomplete interviews were excluded from analysis.

Harvest and Release

Monthly harvest and release, estimated by species and mark group, was the sum of the weekday and weekend/holiday strata estimates. For each stratum, harvest and release was the product of stratum effort and the corresponding value of HPUE or RPUE.

10) Total study period catch (C):

$$C = \sum_h \bar{c}_h E_h$$

Angler Characteristics

Several unweighted angler attributes including mean angler day length, preferred species and gear type, were also summarized by month (Appendix 1a).

Squamish River

Before the analysis algorithms were performed, data were stratified according to month, day type, hour and stint. Days were divided into three stints: the period of overlap between the a.m. and p.m. shifts, and the a.m. and p.m. shifts outside the overlap period. Stratification allowed the appropriate weighting of interview and instantaneous effort count data.

Angler Effort

Angler effort profiles were generated from rod counts at the survey sites and 'time fishing' data from interviews. Effort information from outside the survey shifts (prior to 0700 and after 1800 hours, for example) was reconstructed from the interview data and used to adjust the daily angler effort profile. Hourly effort was also weighted to compensate for the sampling imbalances resulting from overlapping survey shifts. Mean sample day effort for each stratum (month and day type) was the ratio of the mean instantaneous rod count to the proportion of daily effort occurring during the instantaneous effort count time block. Total angler effort was the product of the mean daily angler effort and the number of days in the stratum. The mathematical relationships are reported below, with variance calculations detailed in Schubert and Whyte (1992).

11) Estimated total rods fishing by hour j and day type h:

$$\hat{R}_{hj} = N_h / n_{hj} \sum_k r_{hjk}$$

12) Estimated proportion of the daily angler effort occurring during the instantaneous rod count time block, by day type:

$$\bar{P}_{hj\cdot} = \frac{\hat{R}_{hj\cdot}}{\sum_j \hat{R}_{hj}}$$

13) Estimated mean rod count during the instantaneous rod count time block, by day type:

$$\bar{y}_{hj\cdot} = \sum_k \frac{y_{hj\cdot k}}{n_{hj\cdot}}$$

14) Estimated angler effort by day type, in hours:

$$E_h = N_h \frac{\bar{y}_{hj\cdot}}{\bar{p}_{hj\cdot}}$$

15) Estimated study period angler effort, in hours:

$$E = \sum_h E_h$$

where:

N_h = total study period days of day type h (weekday or weekend);

n_{hj} = number of interview sample days on day type h during hour j;

r_{hjk} = rod count on day type h at hour j on day k;

$\hat{R}_{hj^*}$ = estimated total effort (hours) on day type *h* during the instantaneous count time *j**

y_{hj^*k} = instantaneous rod count on day type *h* on day *k*;

n_{hj^*} = number of instantaneous rod counts on day type *h*;

Catch per Unit Effort

CPUE was calculated by day type for each species and mark group, using a mean of ratios estimator (Von Geldern, Jr. and Thomlinson, 1973; Malvestuto, 1983; Hoenig et al., 1997), i.e., the sum of all the daily ratios of estimated catch to estimated effort (to time of interview) was divided by the total number of anglers interviewed. Estimates were derived from interview data weighted by the proportion of stints that were surveyed. CPUE was calculated separately for harvested (HPUE) and released (RPUE) fish. The mathematical relationships are reported below.

16) Estimated catch per angler hour for angler u:

$$\hat{X}_u = \frac{x_u}{t_u}$$

17) Estimated cumulative catch per angler hour by day type:

$$\hat{c}_h = \sum_l \frac{1}{a_{hl}} \sum_f \sum_q \sum_u \frac{\hat{X}_u}{a_{hlfq}}$$

18) Estimated catch per angler hour by day type:

$$\bar{c}_h = \frac{\hat{c}_h}{n_h}$$

where:

a_{hl} = proportion of monthly stints of type *l* on day type *h* which were surveyed;

a_{hlfq} = proportion of anglers fishing in time block *q* on stint *f* of stint type *l* on day type *h* who were interviewed;

x_u = catch to time of interview by angler *u*;

t_u = hours fished to time of interview by angler *u*;

n_h = total number of anglers interviewed on day type *h*.

Before calculating CPUE, however, the raw interview data were tested for significant differences in CPUE estimates calculated from all interviews and complete trip interviews only, using Equation 9. In the 1998 Squamish River survey, approximately 39% of all interviews were incomplete. None of the incomplete interviews were excluded from analysis.

Harvest and Release

Monthly harvest and release, estimated by species and mark group, was the sum of the weekday and weekend/holiday strata estimates. For each stratum, harvest and release was the product of stratum effort and the corresponding value of HPUE or RPUE, calculated as in Equation 10.

Angler Characteristics

Several unweighted angler attributes including mean angler day length, preferred species and gear type, were also summarized by month (Appendix 1b).

RESULTS

CAPILANO RIVER

The 1998 Capilano River sport fishery survey was conducted from July 1 to October 31 and November 18 to 30, 1998. Catches during the study included coho, chum and chinook salmon, as well as steelhead and other trout species. Survey effort, total angler effort, CPUE, HPUE and RPUE estimates by species and total catch and release estimates by species are described below.

Table 2. Angler effort, survey effort, harvest and release by species and angler characteristics (from interview responses) in the 1998 Capilano River and Squamish River sport fisheries.

	Capilano River	Squamish River
Dates surveyed	July 1 - Oct 31; Nov 18 - 30	Oct 1 - Nov 30
# of interviews	3,666	1,582
Angler effort (hours)	46,873	14,736
Angler effort (days)	17,310	3,988
Average angler day (hours)	2.7	3.7
TOTAL HARVEST		
Chinook	45	0
Jack Chinook	6	0
Coho	1,024	0
Chum	4	1,880
Pink	0	0
Sockeye	0	0
Steelhead	29	0
Trout	74	0
Sturgeon	0	0
Other	546	0
TOTAL RELEASE		
Chinook	237	0
Jack Chinook	2	4
Coho	1,039	172
Chum	45	8,031
Pink	0	0
Sockeye	0	0
Steelhead	444	0
Trout	307	6
Sturgeon	0	0
Other	737	137
TARGET SPECIES (%)		
None	5.5	4.6
Chinook	0.8	0.1
Jack Chinook	0.0	0.0
Coho	88.4	4.2
Chum	0.0	88.8
Pink	0.0	0.0
Sockeye	0.1	0.0
Steelhead	0.2	0.0
Trout	0.4	0.4
Sturgeon	0.0	0.0
Other	4.5	1.8
GEAR TYPE (%)		
Bait	9.3	0.5
Lure	76.7	76.4
Bait and Lure	5.5	0.0
Fly	8.5	23.1

Survey Effort

The study period included 90 weekdays and 46 weekend/holiday days, of which 84% and 97% were sampled, respectively.

Seven instantaneous effort counts were conducted on the Capilano River in July, while 8 took place in August, 5 in each of September and October and 3 in November. Twenty-two of these were morning counts and 6 were evening counts. Rod counts ranged from 3 to 53 on weekdays and from 5 to 38 on weekends (Appendix 2a). The peak rod count for the study area (53 rods) occurred during the evening count on July 16.

Angler Effort

Daily Profile

The majority of anglers fished during the daylight hours (Figure 3). Evening angling decreased from July through November. In general, effort was fairly constant throughout the day, with small peaks in effort in the early morning and effort decreasing in the late afternoon.

Total Angler Effort

Total estimated angler effort for July through October and the latter half of November was 46,873 hours or 17,310 angler days (Table 2). Angling effort was highest in July (19,626 hours) and lowest in November (750 hours), even when taking into account that less than half of November was surveyed. Sixty-four percent of the angling effort took place on weekdays. Angler effort estimates are presented in Table 2 and, by month, in Appendix 4a.

Catch per Unit Effort

Coho salmon CPUEs are presented in Figure 4 and, along with HPUEs and RPUEs, in Appendix 5a. Peak and average CPUEs are described below by month and day type. The proportion of harvested fish to total catch is also described. CPUEs, HPUEs and RPUEs for all other species caught in the study area during the survey are detailed in Appendix 5a.

Average weekend and weekday CPUEs for coho were 0.0590 and 0.0651; weekend and weekday HPUEs averaged 0.0182 and 0.0353. The peak weekend and weekday CPUEs for coho both occurred in November (0.1515 and 0.1467).

Total Catch

Catches of 2,063 coho, 49 chum and 290 chinook salmon, representing 53% of the total sport catch, were estimated for the Capilano River study area from July through October and November 18 to 30. Harvest and release totals for all species are detailed in Table 2 and Appendix 4a.

Coho salmon were caught throughout the study period. Coho salmon catches peaked during July; 43% of the total catch occurred in July. Fifty percent of the total coho salmon catch was harvested.

Marked Catch

Approximately 58% of the coho salmon harvested during the study were recorded as being marked. Marked fish estimates are presented in Table 3. Interview staff did not record mark data for released fish, as angler mark recognition was not considered reliable.

Table 3. Estimated marks by species and month in the 1998 Capilano River sport fishery.

	July	Aug	Sept	Oct	Nov	Total
Chinook	0	0	0	32	0	32
Jack Chinook	0	0	0	0	0	0
Coho	141	12	238	206	0	597
Chum	0	0	0	0	0	0
Pink	0	0	0	0	0	0
Sockeye	0	0	0	0	0	0
Steelhead	0	0	0	0	0	0
Trout	0	0	0	0	0	0

Angler Characteristics

Angler characteristics are presented in Table 2 and Appendix 1a. Eighty-eight percent of the anglers interviewed were targeting coho salmon. Six percent were not targeting any particular species and less

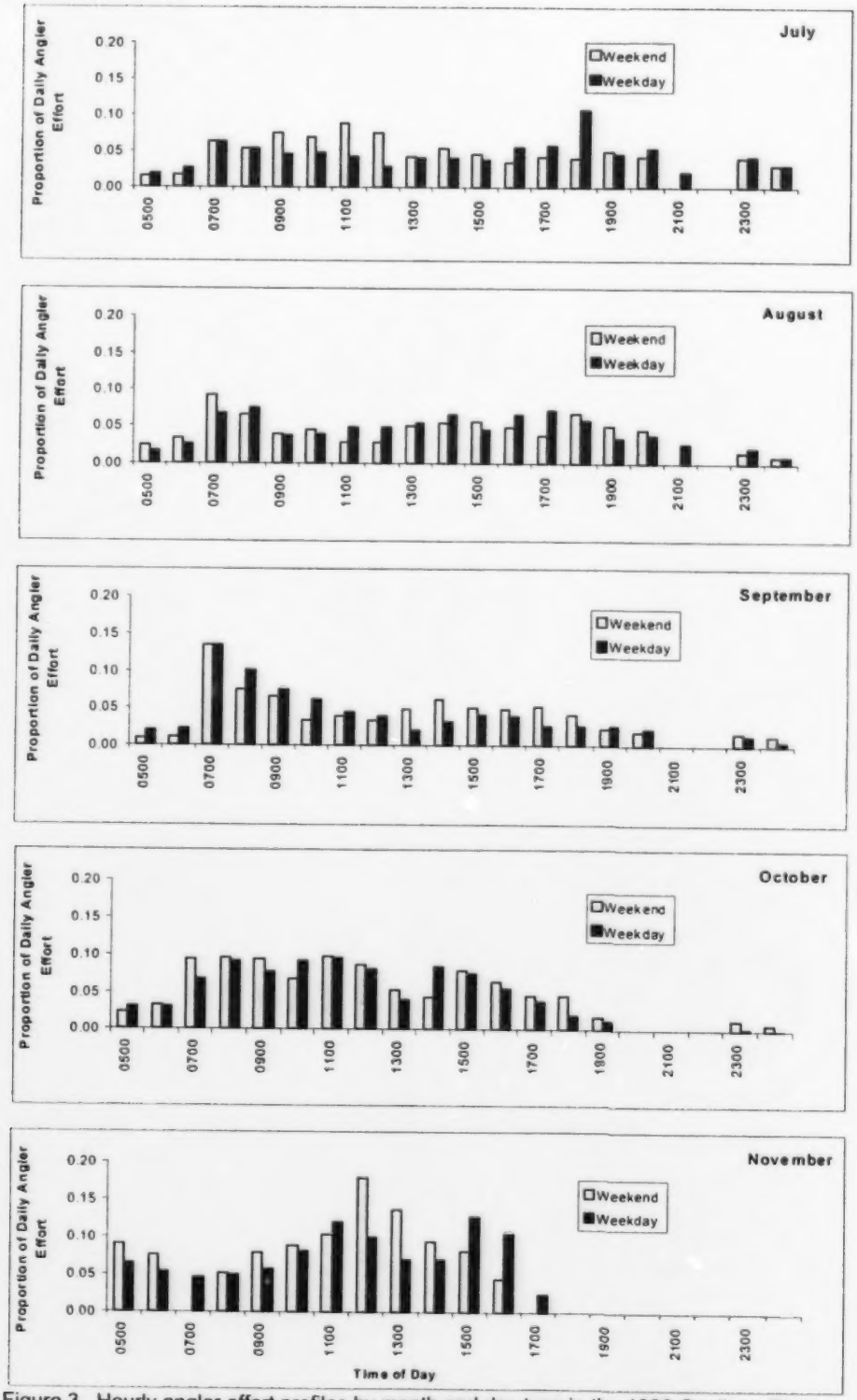

Figure 3. Hourly angler effort profiles by month and day type in the 1998 Capilano River sport fishery.

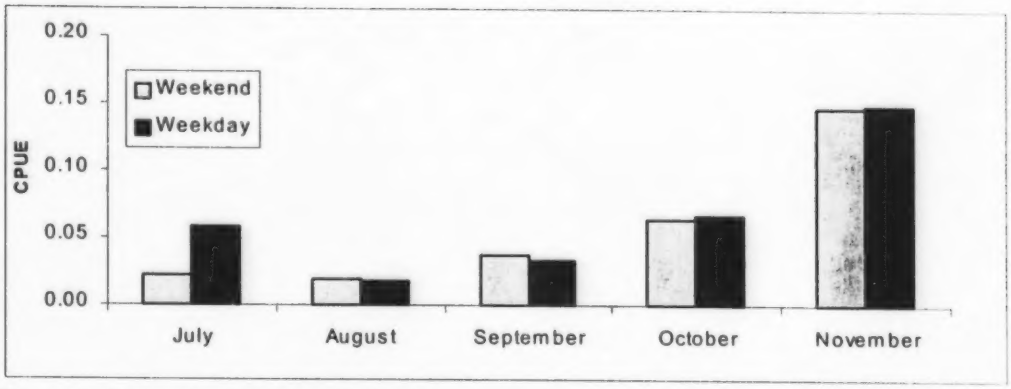

Figure 4. Coho salmon CPUEs by day type and month in the 1998 Capilano River sport fishery.

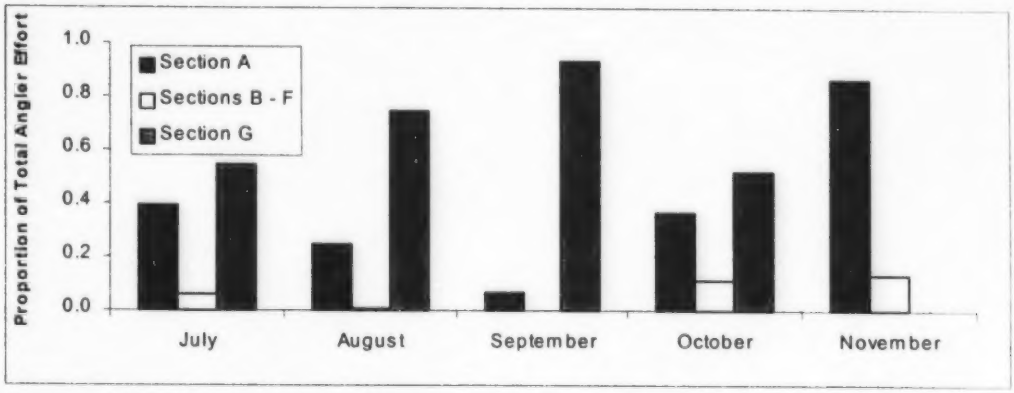

Figure 5. Monthly proportion of angler effort taking place in Sections A, B through F and G during the 1998 Capilano River sport fishery survey.

than 1% targeted each of chinook salmon and steelhead, and trout. Coho salmon was the predominant target species throughout the survey period and was targeted by at least 84% of anglers during every month. Seventy-seven percent of anglers interviewed used lures as their gear type, with the remainder using bait (9%), flies (8%), or bait and lure combinations (6%). Mean angler trip length over the study period was 2.7 hours (Table 2); angler trip length was lowest in November (2.4 hours) and highest during August and September (2.9 hours).

Over the course of the survey, 70% of the angler effort occurred in Section G, near the mouth of the river, while 27% of angler effort took place in Section A, at the top of the study area (Figure 5). Less than 4% of the angler effort occurred in the other 5 sections combined.

SQUAMISH RIVER

The 1998 Squamish River sport fishery survey was conducted between October 1 and November 30, 1998. Catches during the 2-month study included coho, chum and chinook salmon and trout. Survey effort, total angler effort, CPUE, HPUE and RPUE estimates by species and total catch and release by species are described below.

Survey Effort

The study period included 41 weekdays and 20 weekend/holiday days, of which 61% and 90% were sampled, respectively.

Six instantaneous effort counts were conducted over the Squamish River in October and 8 were conducted in November. All instantaneous effort counts covered Sections 1 and 2. Rod counts ranged from 0 to

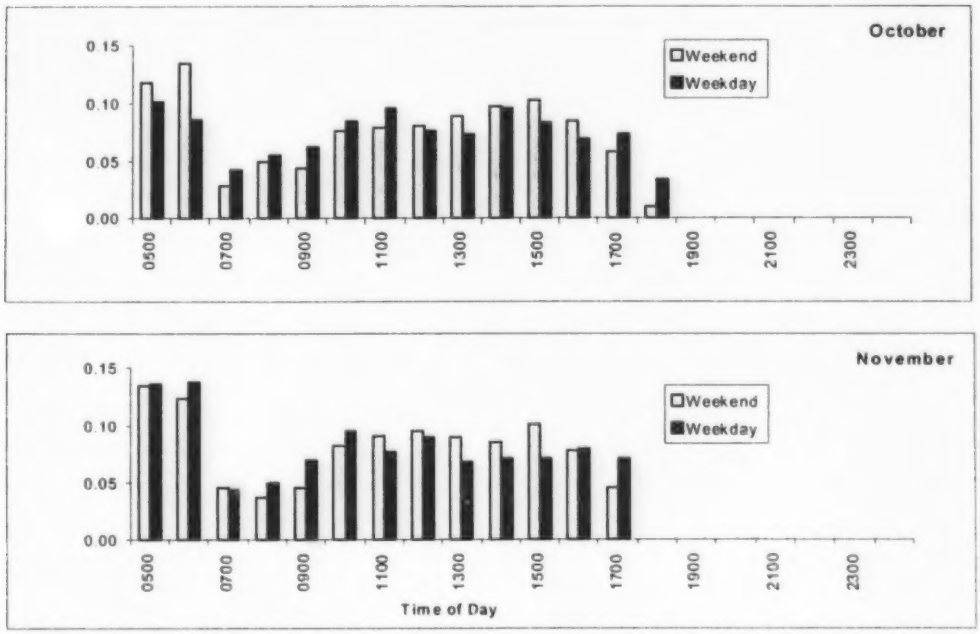

Figure 6. Hourly angler effort profiles by month and day type in the 1998 Squamish River sport fishery.

22 on weekdays and from 11 to 80 on weekends and holidays (Appendix 2b). The peak rod count for the study area (80 rods) occurred on November 7.

Angler Effort

Daily Profile

Anglers fished from early morning until late afternoon (Figure 6). The effort profile shows substantial effort before 0700 hours; some of this effort represents fishing that took place before 0500 hours. Effort throughout the rest of the day was fairly constant, with a small increase in effort from the late morning to the early afternoon.

Total Angler Effort

Total estimated angler effort for October and November was 14,736 hours or 3,988 angler days. Forty-three percent of the angling effort took place on weekdays. Angler effort estimates are presented in Table 2 and, by month, in Appendix 4b.

Catch per Unit Effort

CPUEs for coho and chum salmon are presented in Figure 7 and, along with HPUEs and RPUEs, in Appendix 5b. Peak and average CPUEs are described below by month and day type. The proportion of harvested fish to total catch is also described. CPUEs, HPUEs and RPUEs for all other species caught in the study area during the survey are detailed in Appendix 5b.

Average weekend and weekday CPUEs for coho salmon were 0.0062 and 0.0192; none of the catch was harvested. The peak weekend and weekday CPUEs for coho salmon both occurred in October (0.0110 and 0.0308).

Average weekend and weekday CPUEs for chum salmon were 0.6727 and 0.6746. Approximately one fifth of the total chum salmon catch was harvested; weekend and weekday HPUEs averaged 0.1283 and 0.1313. The peak weekend and weekday CPUEs for chum salmon both occurred in November (0.6897 and 0.9316).

Total Catch

Catches of 172 coho, 9,911 chum and 4 jack chinook salmon, representing 99% of the total sport catch, were estimated for the Squamish River study area for October and

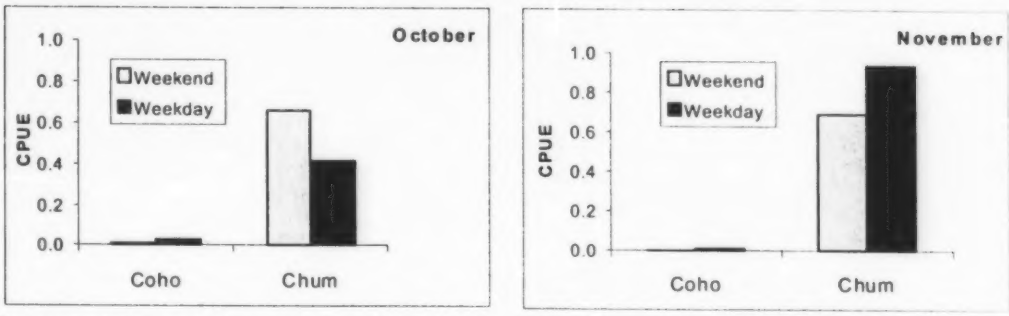

Figure 7. Coho and chum salmon CPUEs by day type and month in the 1998 Squamish River sport fishery.

November. Harvest and release totals for all species are detailed in Table 2 and Appendix 4b.

Coho and chum salmon were both caught during October and November. Most of the coho salmon catches (83%) occurred during October. Chum salmon catches were greatest in November, when 60% of the total catch took place. None of the coho or chinook salmon caught were harvested, while 19% of the chum salmon caught were harvested.

Marked Catch

None of the fish examined during the study was recorded as being marked. Interview staff did not record mark data for released fish, as angler mark recognition was not considered reliable.

Angler Characteristics

Angler characteristics are detailed in Table 2 and Appendix 1b. Eighty-nine percent of the anglers interviewed were targeting chum salmon, while 4% targeted coho salmon and 5% did not target any particular species. Seventy-six percent of anglers interviewed used lures as their gear type, with the remainder using flies (23%) or bait (<1%). Mean angler trip length over the study period was 3.7 hours; angler trip length varied little between months (Table 3).

Over the course of the survey, 69% of the estimated angler effort occurred in Section 1, at the bottom end of the study area, while 31% took place in Section 2.

DISCUSSION

CAPILANO RIVER

The hybrid survey design used in this study incorporated the main advantages of both access point surveys (i.e., high proportion of complete trip interviews) and roving surveys (i.e., able to survey most of the river and interview anglers in a fishery with diffuse access). Because more than 80% of the interviews were conducted at access points, however, and the data was analyzed as access point data, there is a reduced risk of the biased catch rate estimates that are sometimes associated with roving surveys (Robson and Jones, 1989).

When the Capilano River coho salmon fishery was closed to retention on November 1, the decision was made to cancel survey shifts until the fishery re-opened. With coho salmon being the predominant target species of Capilano River anglers, it was believed that fishing effort would drop considerably during the mandatory catch and release period and that the limited survey funds should be conserved to allow the survey to continue until the end of November. As a result, however, we cannot estimate angler effort or catch for November 1-17; effort and catch estimates are reported for November 18- 30 only. It would have been preferable to have data for the entire study period, including the catch and release fishery. The survey would have continued throughout November, had sufficient funding been available.

This survey was undertaken to determine the level of recreational angler effort

and catch and to gather information for future surveys.

SQUAMISH RIVER

A roving creel survey design was chosen to assess the Squamish River fishery because the river has many access points; monitoring one or two of these points would not have allowed for sufficient survey coverage of the anglers on the river.

This survey was undertaken to determine the level of recreational angler effort and catch and to gather information for future surveys.

ESTIMATION OF CPUE

The Capilano River survey was analyzed as an access point survey because more than 80% of the interviews took place at access points. Estimates of CPUEs were calculated using a total ratio, or ratio of means, estimator, a self weighting technique where total observed catch of a particular species group was divided by the total observed effort of all interviewed anglers.

Squamish River CPUEs were calculated using a mean of ratios estimator in which individual angler catch rates were summed and then divided by the number of anglers interviewed. There has been much debate about which of the two estimators is best suited to analyzing roving creel data. In simulation studies that compared the two estimators for calculating catch rates from roving creel survey data, Hoenig et al. (1997) found that applying the mean of ratios estimator almost always resulted in the catch estimates having smaller mean squared error, but only if all trips of less than 30 minutes fishing time were disregarded, as they were in this study.

ESTIMATION OF ANGLER DAY LENGTH

Estimation of angler day length requires the angler to accurately recall trip length to the time of the interview and, if still fishing, to accurately predict subsequent trip length. The ability of anglers to recall trip length and to estimate subsequent trip length was evaluated in the 1989 lower Fraser River sport fishery survey (Schubert, 1992a). While anglers were able to recall trip length with reasonable accuracy, there was a large positive bias when they attempted to estimate subsequent trip length. For this report, therefore, only complete trip interviews were used to estimate angler day length.

SURVEY EFFICIENCY

Survey efficiency (the proportion of the total estimated effort that was interviewed) averaged 15% for the Capilano River survey and 32% for the Squamish River survey. These survey efficiencies compared very favorably to surveys on other systems. Recent lower Fraser River creel surveys have reported survey efficiencies between 9% and 11% (Bratty et al., 1998; Palermo and Thompson, 1999a; Palermo and Thompson, 1999b). Schubert (1992b), when reporting a survey efficiency of 11% for the lower Fraser River creel survey, remarked that it was generally good, especially in comparison to the 4.6% result observed in the 1983 to 1988 Strait of Georgia salmon and groundfish creel survey (Shardlow and Collicutt, 1989) and the 1984 to 1988 Barkley Sound/Alberni Inlet creel survey result of 5.8% (J.O. Thomas and Associates, MS 1988).

INCOMPLETE TRIP INTERVIEW BIAS

A basic assumption underlying creel survey design is that catch per angler hour is independent of trip length, i.e. while anglers fishing long periods will catch more fish, their CPUE will be similar to those fishing shorter periods. This assumption has two implications: a) although roving surveyors have a higher probability of contacting anglers who fish longer daily trips, contact frequency will not bias the CPUE estimate; and b) CPUE estimated from incomplete trip interviews will provide an unbiased estimate of CPUE from complete trip interviews.

This assumption is an important one in any study that has a roving survey component because most interviews are from incomplete trips and are subject to length-of-stay bias (Pollock et al., 1994). The 1998 data from the Capilano and Squamish rivers studies were tested for violation of the assumption by comparing HPUE from com-

plete trip and all interviews. No significant differences were noted; therefore, it was concluded that the assumption was not violated in either study and CPUE estimates could be considered unbiased.

ENVIRONMENTAL CONDITIONS

Interannual variation in environmental conditions can influence the timing and effectiveness of a fishery. Schubert and Whyte (1992) have shown that river level can affect both angler effort and success. High river levels may flood fishing sites, making them inaccessible to anglers. Also, the proportion of a run that is vulnerable to a fishery is affected by river discharge, since river discharge affects migration timing.

This report will not attempt to draw conclusions about the effects of environmental conditions on the fisheries investigated, but flow rates for the upper Capilano River and the Squamish River are presented in Figures 8 and 9, to allow for comparison with future studies. Unfortunately, flow data are not available for the Capilano River downstream of the dam; data for the upper river do not necessarily reflect the flow situation on the lower river.

RECOMMENDATIONS

It is commonly believed that sport fishing effort has increased on rivers in and around the Lower Mainland as a result of increased population levels in the area. Therefore, we recommend that the Capilano and Squamish rivers continue to be assessed to allow for interannual comparisons of effort and catch, and to monitor angling pressure on these systems. In addition, the interruption in surveying on the Capilano River during the November coho salmon fishery closure prevented estimation of angler effort and catch for the month of November. Future assessments need to be sufficiently funded to prevent any such interruptions in survey effort.

Further recommendations regarding the general evaluation of recreational fisheries are discussed by Schubert (1995).

SUMMARY

1. An assessment of the summer and autumn sport fishery on the Capilano River was conducted from July 1 to October 31 and November 18 to 30, 1998. The Squamish River autumn sport fishery was assessed between September 1 and November 30, 1998. Both fisheries were managed by daily and annual catch limits, fish size restrictions, area closures and species-specific fishery closures.

2. The Capilano River fishery was assessed by a combination roving, access point and instantaneous effort count survey, while the Squamish River study combined roving and instantaneous effort count methods.

3. Each fishery was assessed by two surveyors. The surveyors recorded the following information during 3,666 Capilano River and 1,582 Squamish River angler interviews: trip length, target species, number and species of fish harvested and released, identifying marks on harvested fish and gear type.

4. Total angler effort in the Capilano River fishery was estimated at 46,873 hours or 17,310 angler days, while anglers fished for 14,736 hours or 3,988 angler days on the Squamish River. Coho salmon was the predominant target species on the Capilano River; most Squamish River anglers targeted chum salmon.

5. In the Capilano River fishery, total harvests of coho and chum salmon were estimated at 1,024 and 4; the chinook salmon harvest was estimated to be 45 adults and 6 jacks. On the Squamish River, the total harvest of chum salmon was estimated at 1,880; no other species was harvested.

6. In the Capilano River fishery, total releases of coho and chum salmon were estimated at 1,039 and 45, while releases of chinook were estimated at 237 adults and 2 jacks. On the

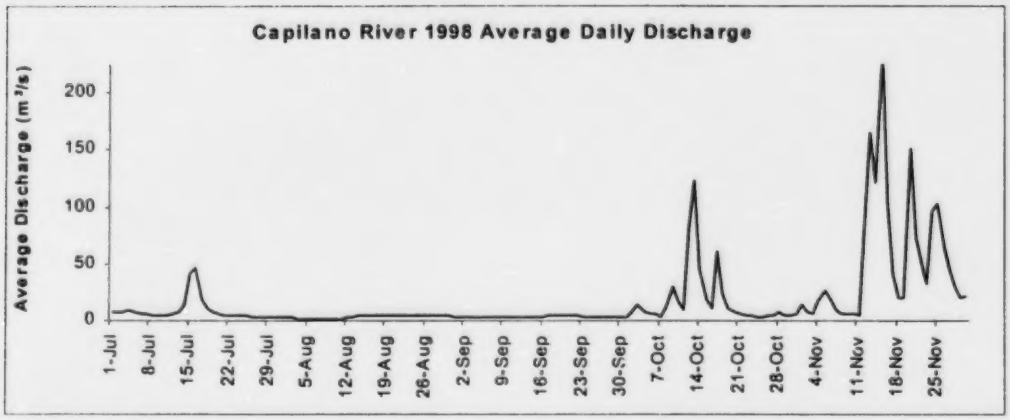

Figure 8. 1998 daily average flows for the upper Capilano River upstream of the dam intake.

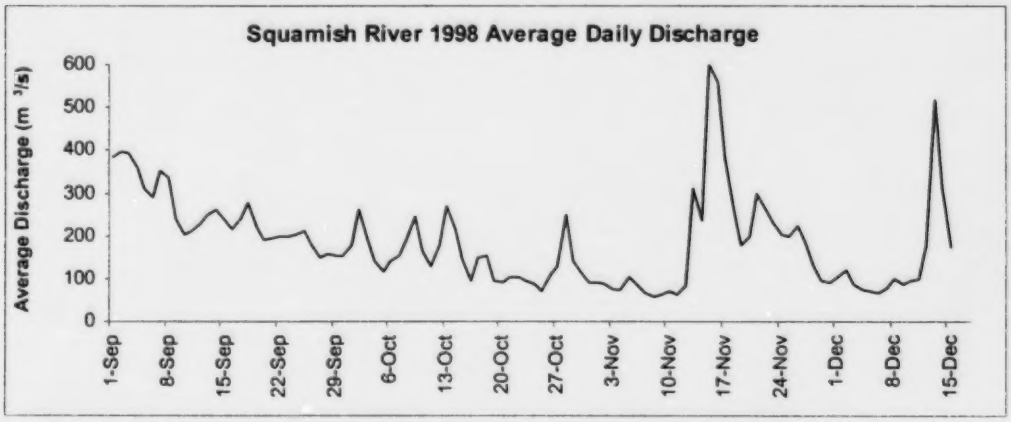

Figure 9. 1998 daily average flows for the Squamish River near Brackendale.

Squamish River, total releases of coho, chum and jack chinook salmon were estimated at 8,031, 172 and 4, respectively.

ACKNOWLEDGMENTS

Over the course of the study period, interviews were conducted by David Veljacic, Dallas Cooper, Scott Ducharme, Randy Marchant and Dawn Marshall. The assistance of the following hatchery staff is gratefully acknowledged: Dave Celli at Tenderfoot Creek Hatchery and Robin Dickson at Capilano River Hatchery. Special thanks to all the anglers who willingly provided both time and information to the 1998 Capilano and Squamish sport fishery surveys.

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APPENDICES

Appendix 1a. Month-specific interview responses in the 1998 Capilano River sport fishery survey.

		July	August	September	October	November	Total or (mean)
Number of Interviews		995	961	999	600	111	3,666
Mean Angler Day Length		2.6	2.9	2.9	2.6	2.4	2.7
Target Species	None	4.9	6.2	6.9	4.2	0.0	5.5
	Chinook	1.8	1.2	0.0	0.0	0.0	0.8
	Coho	0.0	0.0	0.0	0.0	0.0	0.0
	Chum	89.1	83.6	86.9	95.8	96.4	88.4
	Pink	0.0	0.0	0.0	0.0	0.0	0.0
	Sockeye	0.0	0.0	0.0	0.0	0.0	0.0
	Steelhead	0.0	0.0	0.4	0.0	0.0	0.1
	Trout	0.0	0.4	0.0	0.0	3.6	0.2
	Sturgeon	0.4	0.5	0.6	0.0	0.0	0.4
	Jack Chinook	0.0	0.0	0.0	0.0	0.0	0.0
	Other	3.7	8.0	5.2	0.0	0.0	4.5
Gear	Bait	18.7	7.5	5.8	0.0	21.6	9.3
	Lure	57.8	80.3	84.1	90.7	73.0	76.7
	Bait and Lure	7.6	4.7	5.1	4.2	5.4	5.5
	Fly	15.9	7.5	5.0	5.2	0.0	8.5

Appendix 1b. Month-specific interview responses in the 1998 Squamish River sport fishery survey.

		October	November	Total or (mean)
Number of Interviews		678	904	1,582
Mean Angler Day Length		3.8	3.6	(3.7)
Target Species	None	5.9	3.7	(4.6)
	Chinook	0.3	0.0	(0.1)
	Coho	0.0	0.0	(0.0)
	Chum	5.6	3.2	(4.2)
	Pink	85.8	91.0	(88.8)
	Sockeye	0.0	0.0	(0.0)
	Steelhead	0.0	0.0	(0.0)
	Trout	0.0	0.0	(0.0)
	Sturgeon	0.7	0.1	(0.4)
	Jack Chinook	0.0	0.0	(0.0)
	Other	1.6	2.0	(1.8)
Gear	Bait	1.2	0.0	(0.5)
	Lure	68.7	82.2	(76.4)
	Bait and Lure	0.0	0.0	(0.0)
	Fly	30.1	17.8	(23.1)

Appendix 2a. Instantaneous effort counts in the 1998 Capilano sport fishery survey.

Month	Day	Day of Week	A.M.	P.M.
July	9	Thursday	41	-
	12	Sunday	38	-
	16	Thursday	-	53
	19	Sunday	-	22
	22	Wednesday	-	7
	25	Saturday	15	-
	29	Wednesday	3	-
		Mean	24.3	27.3
August	1	Sunday	7	-
	8	Sunday	15	-
	10	Monday	5	-
	13	Thursday	-	7
	17	Monday	-	10
	21	Friday	9	-
	26	Wednesday	6	-
	30	Sunday	9	-
		Mean	8.5	8.5
September	11	Friday	10	-
	16	Wednesday	-	10
	18	Friday	19	-
	19	Saturday	18	-
	26	Saturday	11	-
		Mean	14.5	10.0
October	11	Sunday	10	-
	21	Wednesday	10	-
	24	Saturday	7	-
	29	Thursday	6	-
	30	Friday	13	-
		Mean	9.2	-
November	12	Thursday	7	-
	19	Thursday	4	-
	28	Saturday	6	-
		Mean	5.7	-

Appendix 2b. Instantaneous effort counts in the 1998 Squamish River sport fishery survey.

Month	Day	Day of Week	Sec. 1	Sec. 2	Total
October	10	Saturday	10	4	14
	12[a]	Monday	9	2	11
	17	Saturday	24	11	35
	21	Wednesday	8	9	17
	24	Saturday	21	26	47
	31	Saturday	20	23	43
		Mean	15.3	12.5	27.8
		Total	92	75	167
		% in section	55	45	100
November	2	Monday	14	8	22
	7	Saturday	54	26	80
	9	Monday	8	7	15
	11[b]	Wednesday	11	6	17
	14	Saturday	14	11	25
	16	Monday	0	0	0
	23	Monday	3	0	3
	28	Saturday	20	10	30
		Mean	15.5	8.5	24.0
		Total	124	68	192
		% in section	65	35	100

[a] Thanksgiving Day Holiday

[b] Remembrance Day Holiday

Appendix 3a. Mean hourly proportion of angler effort by month and day type in the 1998 Capilano River sport fishery survey.

	July		August		September	
Hour	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday
5:00	0.01388	0.01881	0.02493	0.01681	0.00896	0.02025
6:00	0.01619	0.02687	0.03442	0.02615	0.01064	0.02362
7:00	0.06303	0.06200	0.09290	0.06734	0.13470	0.13515
8:00	0.05321	0.05367	0.06511	0.07580	0.07577	0.10028
9:00	0.07467	0.04635	0.03970	0.03706	0.06642	0.07460
10:00	0.06828	0.04797	0.04411	0.03919	0.03461	0.06181
11:00	0.08860	0.04251	0.02735	0.04824	0.04038	0.04541
12:00	0.07426	0.02897	0.02859	0.04874	0.03356	0.03990
13:00	0.04202	0.04010	0.05029	0.05466	0.04911	0.02081
14:00	0.05261	0.03937	0.05470	0.06591	0.06155	0.03216
15:00	0.04658	0.03808	0.05735	0.04526	0.05020	0.04217
16:00	0.03398	0.05535	0.04941	0.06577	0.04802	0.03879
17:00	0.04110	0.05792	0.03706	0.07133	0.05238	0.02595
18:00	0.04056	0.10628	0.06793	0.05744	0.04147	0.02595
19:00	0.04932	0.04638	0.05029	0.03439	0.02357	0.02649
20:00	0.04247	0.05362	0.04500	0.03752	0.01964	0.02270
21:00	0.00000	0.02126	0.00000	0.02501	0.00000	0.00000
22:00	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
23:00	0.03932	0.04084	0.01424	0.02055	0.01625	0.01350
24:00	0.03007	0.03063	0.00950	0.00872	0.01232	0.00675

	October		November	
Hour	Weekend	Weekday	Weekend	Weekday
5:00	0.02366	0.03090	0.09023	0.06383
6:00	0.03238	0.03004	0.07519	0.05319
7:00	0.09357	0.06782	0.00000	0.04655
8:00	0.09635	0.09221	0.05177	0.04987
9:00	0.09403	0.07667	0.08000	0.05652
10:00	0.06855	0.09233	0.08785	0.08146
11:00	0.09866	0.09526	0.10353	0.11970
12:00	0.08616	0.07992	0.17883	0.09892
13:00	0.05373	0.03993	0.13647	0.06982
14:00	0.04299	0.08501	0.09412	0.06982
15:00	0.07893	0.07578	0.08157	0.12801
16:00	0.06485	0.05451	0.04392	0.10474
17:00	0.04521	0.03821	0.00000	0.02327
18:00	0.04447	0.01910	0.00000	0.00000
19:00	0.01668	0.01146	0.00000	0.00000
20:00	0.00000	0.00000	0.00000	0.00000
21:00	0.00000	0.00000	0.00000	0.00000
22:00	0.00000	0.00000	0.00000	0.00000
23:00	0.01370	0.00172	0.00000	0.00000
24:00	0.00872	0.00086	0.00000	0.00000

Appendix 3b. Mean hourly proportion of angler effort by month and day type in the 1998 Squamish River sport fishery survey.

	October		November	
Hour	Weekend	Weekday	Weekend	Weekday
5:00	0.11816	0.10060	0.13515	0.13622
6:00	0.13418	0.08566	0.12423	0.13810
7:00	0.02902	0.04247	0.04576	0.04350
8:00	0.04892	0.05498	0.03628	0.04938
9:00	0.04436	0.06147	0.04478	0.06928
10:00	0.07532	0.08494	0.08286	0.09504
11:00	0.07917	0.09583	0.09109	0.07667
12:00	0.08043	0.07599	0.09479	0.08965
13:00	0.08914	0.07376	0.08978	0.06836
14:00	0.09674	0.09483	0.08446	0.07166
15:00	0.10199	0.08270	0.10133	0.07128
16:00	0.08430	0.06873	0.07779	0.07936
17:00	0.05804	0.07376	0.04511	0.07054
18:00	0.01106	0.03353	0.00000	0.00000
19:00	0.00000	0.00000	0.00000	0.00000
20:00	0.00000	0.00000	0.00000	0.00000
21:00	0.00000	0.00000	0.00000	0.00000
22:00	0.00000	0.00000	0.00000	0.00000
23:00	0.00000	0.00000	0.00000	0.00000
24:00	0.00000	0.00000	0.00000	0.00000

Appendix 4a. Estimated angler effort, harvest and release by month and species in the 1998 Capilano River sport fishery.

	July	August	September	October	November[a]	Total
# of interviews	995	961	999	600	111	3,666
# of instant. effort counts	7	8	5	5	3	28
ANGLER EFFORT						
Estimated effort (hours)	19,626	7,212	11,436	7,849	750	46,873
Estimated effort (days)	7,549	2,487	3,943	3,019	312	17,310
Average angler day (hours)	2.6	2.9	2.9	2.6	2.4	2.7
ESTIMATED HARVEST						
Chinook	5	0	6	32	2	45
Jack Chinook	0	0	2	4	0	6
Coho	326	64	364	225	45	1,024
Chum	0	0	4	0	0	4
Pink	0	0	0	0	0	0
Sockeye	0	0	0	0	0	0
Steelhead	29	0	0	0	0	29
Trout	48	2	19	5	0	74
Sturgeon	0	0	0	0	0	0
Other	266	201	79	0	0	546
ESTIMATED RELEASE						
Chinook	5	0	0	193	39	237
Jack Chinook	0	0	0	0	2	2
Coho	564	74	38	297	66	1,039
Chum	0	0	0	21	24	45
Pink	0	0	0	0	0	0
Sockeye	0	0	0	0	0	0
Steelhead	414	18	7	5	0	444
Trout	196	48	52	11	0	307
Sturgeon	0	0	0	0	0	0
Other	543	148	38	8	0	737
TOTAL CATCH						
Chinook	10	0	6	225	41	282
Jack Chinook	0	0	2	4	2	8
Coho	890	138	402	522	111	2,063
Chum	0	0	4	21	24	49
Pink	0	0	0	0	0	0
Sockeye	0	0	0	0	0	0
Steelhead	443	18	7	5	0	473
Trout	244	50	71	16	0	381
Sturgeon	0	0	0	0	0	0
Other	809	349	117	8	0	1,283

[a] For the period November 18 – 30 only

Appendix 4b. Estimated angler effort, harvest and release by month and species in the 1998 Squamish River sport fishery.

	October	November	Total
# of interviews	678	904	1,582
# of instant. effort counts	6	8	14
ANGLER EFFORT			
Estimated effort (hours)	7,165	7,571	14,736
Estimated effort (days)	1,885	2,103	3,988
Average angler day (hours)	3.8	3.6	3.7
ESTIMATED HARVEST			
Chinook	0	0	0
Jack Chinook	0	0	0
Coho	0	0	0
Chum	1,129	751	1,880
Pink	0	0	0
Sockeye	0	0	0
Steelhead	0	0	0
Trout	0	0	0
Sturgeon	0	0	0
Other	0	0	0
ESTIMATED RELEASE			
Chinook	0	0	0
Jack Chinook	4	0	4
Coho	142	30	172
Chum	2,804	5,227	8,031
Pink	0	0	0
Sockeye	0	0	0
Steelhead	0	0	0
Trout	6	0	6
Sturgeon	0	0	0
Other	137	0	137
TOTAL CATCH			
Chinook	0	0	0
Jack Chinook	4	0	4
Coho	142	30	172
Chum	3,933	5,978	9,911
Pink	0	0	0
Sockeye	0	0	0
Steelhead	0	0	0
Trout	6	0	6
Sturgeon	0	0	0
Other	137	0	137

Appendix 5a. Mean monthly HPUE, RPUE and CPUE by month, day type and species in the 1998 Capilano River sport fishery.

Weekend	Month	Chinook	Jack chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	July	0	0	0.0106	0	0	0	0.0040	0.0060	0	0.0103
	August	0	0	0.0064	0	0	0	0	0.0005	0	0.0211
	September	0.0006	0.0006	0.0350	0	0	0	0	0	0	0.0062
	October	0.0016	0.0021	0.0390	0	0	0	0	0	0	0
	November	0	0	0	0	0	0	0	0	0	0
RPUE	July	0	0	0.0113	0	0	0	0.0392	0.0113	0	0.0204
	August	0	0	0.0130	0	0	0	0.0030	0.0099	0	0.0254
	September	0	0	0.0030	0	0	0	0.0019	0.0035	0	0.0030
	October	0.0297	0	0.0254	0	0	0	0	0.0011	0	0
	November	0.0481	0	0.1515	0	0	0	0	0	0	0
Total	July	0	0	0.0219	0	0	0	0.0432	0.0174	0	0.0307
(CPUE)	August	0	0	0.0195	0	0	0	0.0030	0.0104	0	0.0465
	September	0.0006	0.0006	0.0380	0	0	0	0.0019	0.0035	0	0.0092
	October	0.0313	0.0021	0.0644	0	0	0	0	0.0011	0	0
	November	0.0481	0	0.1515	0	0	0	0	0	0	0

Weekday	Month	Chinook	Jack chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	July	0.0004	0	0.0201	0	0	0	0	0.0004	0	0.0155
	August	0	0	0.0115	0	0	0	0	0	0	0.0352
	September	0.0005	0	0.0303	0.0005	0	0	0	0.0025	0	0.0073
	October	0.0049	0	0.0253	0	0	0	0	0.0008	0	0
	November	0.0034	0	0.0895	0	0	0	0	0	0	0
RPUE	July	0.0004	0	0.0388	0	0	0	0.0108	0.0092	0	0.0318
	August	0	0	0.0072	0	0	0	0.0021	0.0032	0	0.0151
	September	0	0	0.0034	0	0	0	0	0.0050	0	0.0035
	October	0.0229	0	0.0421	0.0035	0	0	0.0009	0.0016	0	0.0014
	November	0.0542	0.0034	0.0573	0.0474	0	0	0	0	0	0
Total	July	0.0008	0	0.0588	0	0	0	0.0108	0.0096	0	0.0473
(CPUE)	August	0	0	0.0187	0	0	0	0.0021	0.0032	0	0.0504
	September	0.0005	0	0.0337	0.0005	0	0	0	0.0076	0	0.0108
	October	0.0278	0	0.0673	0.0035	0	0	0.0009	0.0024	0	0.0014
	November	0.0576	0.0034	0.1467	0.0474	0	0	0	0	0	0

Appendix 5b. Mean monthly HPUE, RPUE and CPUE by month, day type and species in the 1998 Squamish River sport fishery.

Weekend

	Month	Chinook	Jack chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	October	0	0	0	0.1879	0	0	0	0	0	0
	November	0	0	0	0.0688	0	0	0	0	0	0
RPUE	October	0	0	0.0110	0.4678	0	0	0	0	0	0.0038
	November	0	0	0.0014	0.6209	0	0	0	0	0	0
Total	October	0	0	0.0110	0.6557	0	0	0	0	0	0.0038
(CPUE)	November	0	0	0.0014	0.6897	0	0	0	0	0	0

Weekday

	Month	Chinook	Jack chinook	Coho	Chum	Pink	Sockeye	Steelhead	Trout	Sturgeon	Other
HPUE	October	0	0	0	0.1202	0	0	0	0	0	0
	November	0	0	0	0.1423	0	0	0	0	0	0
RPUE	October	0	0.0012	0.0308	0.2973	0	0	0	0.0019	0	0.0381
	November	0	0	0.0077	0.7893	0	0	0	0	0	0
Total	October	0	0.0012	0.0308	0.4176	0	0	0	0.0019	0	0.0381
(CPUE)	November	0	0	0.0077	0.9316	0	0	0	0	0	0